Calculation Sheet

whessoe

SPARROWS POINT LNG

IMPOUNDING SYSTEM CAPACITY CALCULATION

1	Issued for FERC Filing	PJE	8/12/06				
0	Issued for FERC Filing	PJE	7/12/06				
Rev	Details	Made By	Date	Chk'd By	Date	App'd By	Date

Client	AES Sparrow Point LNG			Project No.	28
Made By P J Evans	Date 07/12/2006	Chk'd By	Date	Approved By	Date
Title	Impounding System Capacity Calculation			Rev	Sheet
Calculation No.	W0288-000-ME-CA-002			1	1 of 3

Introduction

The concrete outer tank shall be capable of holding 110% of the inner tank capacity in the event of an inner tank failure, in accordance with 49 CFR 193 - Transport - Section 193.2181.
The interspace between the inner and outer tanks comprises of an insulation system of perlite and resilient blanket.

The perlite will create little reduction in the available volume in the interspace in the event of a leak.
This is because:-
1) The presence of interstitial voids between the perlite granules
2) Each perlite granule is a hollow skeletal shell (after expansion)

Reference Whessoe Development Report Doc. No. SW00-RD-RD-007 Rev2 'Absorption of Fluid in Perlite'
This demonstrates that the epanded perlite, compacted by 10% of its loose volume, displaces 25% of its compacted volume in liquid (i.e. absorbtion rate of fluid in perlite is 75% by volume)

Calculation

The maximum liquid level in the inner tank is $L_{max} := 38.67m$ $\qquad L_{max} = 126.87\,ft$

The cold diameter of the inner tank is $D_{cold} := 74.846m$ $\qquad D_{cold} = 245.558\,ft$

Therefore 110% of the volume of the inner tank is:-

$$V_{110} := \frac{\pi}{4} \cdot D_{cold}^{2} \cdot L_{max} \cdot 1.1 \qquad V_{110} = 187152\,m^3 \qquad V_{110} = 6609202\,ft^3$$

The inside diameter of the outer tank is $D_{outer} = 77.419\,m$ $\qquad D_{outer} = 254\,ft$

The uncompressed thickness of resilient blanket is $t_{resun} = 0.406\,m$ $\qquad t_{resun} = 16\,in$

The compressed thickness of the blanket will be 2/3 of this thickness

$$t_{rescomp} := \frac{2}{3} \cdot t_{resun} \qquad t_{rescomp} = 0.271\,m \qquad t_{rescomp} = 10.667\,in$$

The following calculation will assume that the resilient blanket will not absorb LNG (conservative)

Average shell thickness $t_{av} := 17mm$ $\qquad t_{av} = 0.669\,in$

The outside diameter of the blanket is $D_{blkt} := D_{cold} + 2 \cdot t_{rescomp} + 2 \cdot t_{av}$

$$D_{blkt} = 75.422\,m \qquad D_{blkt} = 247.447\,ft$$

The bottom corner protection system will extend into the interspace by	$H_{bcp} := 4.5m$	$H_{bcp} = 14.764\,ft$
The thickness of the bottom corner protection (including 9% nickel steel thickness)	$t_{bcp} := 80mm$	$t_{bcp} = 3.15\,in$

The inner diameter of the bottom corner protection is $D_{bcp} := D_{outer} - 2 \cdot t_{bcp}$

Impounding capacity of interspace in the region of the bottom corner protection system is

$$V_{bcp} := \frac{\pi}{4} \cdot \left[0.75 \cdot \left(D_{bcp}^{\;2} - D_{blkt}^{\;2}\right) + D_{cold}^{\;2}\right] \cdot H_{bcp}$$

	$V_{bcp} = 20542\,m^3$	$V_{bcp} = 725449\,ft^3$
Thickness of base insulation system	$t_{bins} = 0.559\,m$	$t_{bins} = 22\,in$
The inside height of the outer tank to the spring point is	$H_{out} = 41.91\,m$	$H_{out} = 137.5\,ft$
Height of outer tank, above bottom corner protection	$H_{outrem} := H_{out} - t_{bins} - H_{bcp}$	
	$H_{outrem} = 36.851\,m$	$H_{outrem} = 120.903\,ft$

Impounding capacity, above the bottom corner protection is

$$V_{rem} := \frac{\pi}{4} \cdot \left[0.75 \cdot \left(D_{outer}^{\;2} - D_{blkt}^{\;2}\right) + D_{cold}^{\;2}\right] \cdot H_{outrem}$$

	$V_{rem} = 168762\,m^3$	$V_{rem} = 5959787\,ft^3$
Total impounding capacity	$V_{imptot} := V_{bcp} + V_{rem}$	
	$V_{imptot} = 189305\,m^3$	$V_{imptot} = 6685236\,ft^3$
Required capacity	$V_{110} = 187152\,m^3$	$V_{110} = 6609202\,ft^3$

The above calculation demonstrates that the outer tank can contain 110% of the inner tank contents, even with the conservative assumption that the resilient blanket does not absorb any LNG.